MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/2023

DME5116 – ENGINEERING DESIGN

(Diploma in Mechanical Engineering)

3 JULY 2023
2.30 p.m. - 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 2 pages excluding the cover page with 5 Questions only.

2. Attempt all **FIVE** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1

a) Define Mechanical Design in your own words [2 marks]

b) Briefly explain SEVEN product design considerations that formulate a plan for the satisfaction of a specified need. This process requires innovation, iteration, decision-making, and communication intensiveness.

[14 marks]

c) Briefly explain the two most common hardness-measuring systems.

[4 marks]

Question 2

a) An AISI 1018 steel has a yield strength, S_y = 295MPa. Using the distortion-energy theory for the given state of plane stress, determine the factor of safety.

σ_x (MPa)	σ_y (MPa)	τ_{xy} (MPa)
-80	30	-10

[10 marks]

b) A material at 427°C exhibits yield strength (tension), S_{yt} = 235MPa, yield strength (compression) S_{yc} = 285MPa, and engineering strain, ε_f = 0.07. For the given state of plane stress, determine the factor of safety.

σ_x (MPa)	σ_y (MPa)	τ_{xy} (MPa)
125	0	-75

[10 marks]

Question 3

A steel bar undergoes cyclic loading such that maximum stress, σ_{max} = 420MPa and minimum stress σ_{min} = -140MPa. For the material, ultimate tensile strength, S_{ut} = 560MPa, yield strength, S_y = 455MPa, a fully corrected endurance limit of S_e = 280MPa, and fatigue strength fraction, f = 0.9. Estimate the number of cycles to a fatigue failure using:

i. Modified Goodman criterion. [16 marks]
ii. Gerber criterion. [4 marks]

Continued ...

Question 4

A M14 x 2 hex-head bolt with a nut is used to clamp together two 15mm steel plates. There was one 14R metric plain washer under the nut.

i. Determine a suitable length for the bolt, rounded up to the nearest 5mm. [4 marks]

ii. Determine the bolt stiffness. [6 marks]

iii. Determine the stiffness of the members. [10 marks]

Question 5

A steel bar of thickness h, to be used as a beam, is welded to a vertical support by two fillet welds as shown in the Figure Q5.

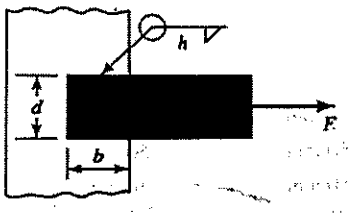

Figure Q5

Table Q5: Information of Figure Q5

b	c	d	h	$\tau_{allow.}$
50mm	150mm	50mm	5mm	140MPa

i. Find the safe bending force F if the allowable shear stress in the welds is $\tau_{allow.}$ [10 marks]

ii. From (a), find the allowable load if the electrode is E7010, the bar is hot-rolled 1020, and the support is hot-rolled 1015. [10 marks]

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